Short Resume/Synopsis of Ph.D. Topic

Entitled

"STUDIES ON TAXONOMIC DIVERSITY AND DISTINCTNESS OF HELMINTH PARASITES OF *GALLUS DOMESTICUS* (LINNAEUS, 1758)"

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"STUDIES ON TAXONOMIC DIVERSITY AND DISTINCTNESS OF HELMINTH PARASITES OF *GALLUS DOMESTICUS* (LINNAEUS, 1758)"

1. A brief resume of proposed work / problem

Poultry products are considered as reasonable source of protein rich diet. In India chicken dominates over the other species reared in poultry. This chicken production system is challenged by diseases, predators, feed shortage, etc. Among the problems facing extensive types of production of chickens are parasitic diseases. Helminthiasis is considered to be an important problem of local chickens and helminth parasites were identified as one of the major causes of health deterioration and loss of productivity. Fundamental research on parasitic helminths is limited in comparison with other fields. This results in a relatively small knowledge base to exploit in the discovery of novel therapeutics or control strategies. A good knowledge of the parasites of domestic chickens, species composition and predilection site is essential for rapid disease diagnosis and treatment.

2. Introduction to proposed research topic:

The term 'Poultry' indicates rearing of domestic avian species like chicken, duck, ostrich, geese, etc. Amongst these species chicken dominates in the country for poultry production. It is one of the rapidly growing sectors of livestock rearing industry in India. It serves as an important source for protein supplementation value. In world India ranks third with respect to poultry egg production and it is world's seventh largest country for poultry meat production. Poultry in India contributes Rs. 70,000/- Crores to national GDP and provides employment to more than 4 million people directly or indirectly. Poultry litter as well is a valuable organic fertilizer & it is produced as a byproduct. Poultry production in some states of the country is remarkable. The states Andhra Pradesh, Telangana, Tamilnadu lead the country followed by Maharashtra, Punjab and West Bengal.

The chicken, *Gallus domesticus* is believed to have descended from the wild Indian and South East Asian red jungle fowl (Permin and Ranvig, 2001). The bird provides human with high nutritional value and other socio-economic benefits which cannot be overemphasized (Martur, 2000). Besides providing employment and income for small-scale farmers particularly in the off cropping season, poultry integrates very well into other farming activities like cropping and fish farming (Aini *et al*., 1990). Poultry, primarily chickens, are the most extensively reared livestock worldwide and the most abundant animal species. Poultry products have been reported as one of the most vital sources of protein for human worldwide. Chickens play an important role in the purveyance of animal protein. Both poultry meat and eggs are

reasonable sources and are directly associated with the rural economic situation of the country. Poultry production plays a vital role for food security and contributes to the country's economy. It is a promising farming activity, particularly in the regions where there is a consistent decrease of grazing areas. Over the years there has been an increase in attention given to the health care of the birds by poultry farmers. Beside its advantage as a source of food and income, scavenging chicken production ensures employment opportunities for rural smallholder farmers and offers socio-cultural advantages. However, the scavenging chicken production system is challenged by diseases, predators, feed shortage, and traditional husbandry practices.

The increased mortality and decreased productivity in chickens is mainly due to mismanagement, lack of nutritional feeding, diseases and predation. Among the problems facing extensive types of production of chickens are parasitic diseases. Helminthiasis is considered to be an important problem of local chickens and helminth parasites were incriminated as major causes of health deterioration and loss of productivity. The term *helminth* is derived from the Greek words *helmins* or *helminthos* meaning 'worms'. There are numerous species of helminth parasites that cause significant damage to the organs in which they live. Avian helminthiasis constitutes one of the most common endoparasitism causing serious troubles in chicken production.

The prevalence and intensity of helminth infections in birds may be influenced by several factors such as distribution of intermediate hosts such as beetles, ants, crustaceans, houseflies etc. and their infection rate and the number of infective parasite eggs or larvae. The free ranging management system and climatic conditions, such as temperature and humidity alter the population dynamics of parasites resulting in dramatic change in prevalence and intensity of helminth infections. Parasitism possesses higher rank amongst factors that serve as a threat to chickens, the presence of a few parasites does not usually cause a problem. However, large numbers can have highly destructive effect on growth, egg production, and overall health. The concentration of parasite eggs in the chickens has been attributed to limited housing and veterinary care services; the environment plays a major role in determining the severity of the infection. The chickens pick up the parasite eggs directly by ingesting contaminated feed, water, litter or by eating snails, earthworms, millipedes and other insects which can carry the eggs of the parasites (Gary & Richard, 2012). Helminth parasites commonly found in chickens include Nematodes, Cestodes, and Trematodes.

Therefore, the objective of this study is to understand the occurrence, magnitude and cause of major diseases of chicken across season, breed and age group and to recommend effective control/ prevention methods. A good knowledge of the parasites of domestic

chickens, species composition and predilection site is essential for prompt disease diagnosis and treatment. This study explored the gastrointestinal parasites of the domestic chicken (*Gallus domesticus*) in and around Pune district, Maharashtra.

Keeping in view the increasing importance of poultry as a cheap source of protein rich diet, the present study is undertaken to investigate some important aspects such as taxonomic diversity, distinctness, abundance & histopathogenesity of Helminth parasites of domestic fowls from Pune district.

3. Survey or review of literature and development in the relevant subject:

As per Kunlayaphat Wuthijaree et al (2019) studies it was concluded that the vast majority of Thai indigenous chicken under the common extensive backyard production conditions were subclinical infected with multiple helminth species even when slaughtered for meat production.

Studies done by G.S. Silva et al (2016) indicated the presence of parasitic nematodes, cestodes, and trematodes in domestic chickens in study area of São Paulo. Nematodes were observed in the small intestine (*Ascaridia galli, Capillaria spp*., and *Strongyloides sp*.), cecum (*Heterakis gallinarum* and *Capillaria sp*.), gizzard (*Cheylospirura hamulosa*), crop (*Capillaria sp.*) and eye (*Oxyspirura mansoni*) which supports the results of Costa et al. (1986). *Heterakis* were the most commonly diagnosed nematodes in domestic chickens. *Ascaridia galli* and *Heterakis gallinarum* were the most frequently observed nematodes. *Ascaridia*, *Capillaria* and *Oxyspirura mansoni* present in chickens originating from the state of São Paulo.

As per the study conducted by Imam et al (2017), 72 % prevalence of intestinal helminths infection was found in chickens. It indicated that in the study area nematodes and cestodes are highly significant helminth problems of local chickens, the most common helminths of chickens are the cestodes. The most prevalent parasite affecting chickens in the study area was *R. tetragona*, the prevalence of the parasites was observed higher in males than in females. This study recommends that the impact of natural helminth infections and supplementary protein on growth performance of free-range chickens should be investigated.

According to Junaidu H.I. et al (2014), the predilection sites of the parasites in the gastrointestinal tract of the domestic chicken showed that most parasites were found in the small intestine, a few in the large intestine, only *Heterakis gallinarum* was found in the caecum and no parasite was observed in the crop and gizzard of the host. The study indicated that highly significant helminth problems of local free range chicken in the study area are due to cestodes and nematode. Hence there is need to control these helminth parasites by educating

the farmers about disease, impact of the disease, conditions responsible to increase the prevalence of the disease.

As per the studies conducted by Rama Rao K. et al (2018), it was observed that distinction in the nematodes of *Ascaridia galli* prevalence were higher than *Heterakis gallinarum* in the population. Among cestodes prevalence of *Raillietina tetragona* were less than *Raillietina echinobothrida*. This study observed mixed infection of both nematodes and cestodes. As per the study in Karimnagar district it was observed that highest infection caused by *Raillietina tetragona* then *Ascaridia galli* and *Heterakis gallinarum*. Whereas in Khammam district highest parasitic infection caused due to *Raillietina tetragona* followed by *Ascaridia galli*, *Raillietina echinobothrida* and *Heterakis gallinarum*.

As per the findings of Mohammed Balarabe Rabiu, et al (2014) study concluded that in domestic pigeons of Kano Central Metropolis *C. obsignata* was the prevalent gastrointestinal nematode. According to the studies such parasitic infection in pigeons lowers the quality & quantity of meat produced, that leads to decrease in sustainable pigeon production and results in less protein supply for human consumption. It was observed that improper management and inadequate health care responsible for such parasitic infection.

According to studies conducted by Matur, B. M. et al (2010) more attention should be given towards the improvement of the poultry management and care of local breeds of chickens which are usually free ranging. There is therefore, the need to supplement scavenging poultry with energy sources.

According to the studies done by Adang, K.L. et al (2008) *Ascaridia galli* infection could have some histopathological effects on vital organs like heart and kidneys, though no such reports exist as per our knowledge. Such effect on vital organs could lead to high morbidity or mortality, or could lead to secondary infections or even increase the complexity of the courses of other infections or diseases in domestic pigeons. This study recommends to conduct further research on histopathological effects of *Ascaridia galli* infection on the heart and kidney.

According to the studies done by Islam M. R. et al (1988) parasitic infection is common phenomenon in aquatic fowls. Two detailed check lists of helminth parasites of waterfowl are available (Lapage, 1961; McDonald, 1969) and numerous parasites were detected in domestic ducks. However, the pathological importance of most of them is imprecise. In a preliminary study, Qadir (1979) recorded 13 species of helminths from domestic ducks of Bangladesh.

As per the studies done by Ramnath, Dutta (2017) Phosphoenolpyruvate carboxykinase (PEPCK) is involved in glycolysis in the cestode parasite, *Raillietina echinobothrida*; whereas, it executes a gluconeogenic role in its host, *Gallus domesticus*. Because of its differing primary function in the cestode parasite and its host, this enzyme is regarded as a possible anthelmintic

target. This study stresses the potential of findings to validate PEPCK as the anthelmintic drug target for parasitism management.

As per findings of C. Sreedevi et.al (2016) relationship between the prevalence of gastrointestinal parasites and seasonality was observed ($\chi 2 = 17.46$, df = 2) to be significant ($p = 0.001$). Data indicated highest prevalence in the rainy season (43.41 %) then in summer (38.91 %) and winter (17.68 %) seasons for all parasites except for *A. galli* and *C. annulata* infections. *A. galli* and *C. annulata* infections were observed higher during summer season. Results indicated high prevalence of gastrointestinal parasites in desi fowl that suggests the need of improvement in poultry management practices.

As per the studies conducted by Anders Permin (2020) the untreated individuals had a significantly higher worm infection than treated one. At the end of experiment all untreated chickens showed a significantly lower weight gain than treated chickens. Economic calculations indicated that in free-range chickens the net profit per hen significantly increased following the treatment of hens against parasitic infections.

According to the studies of David J. Timson (2016) fundamental research on parasitic helminths is limited as compared to fields such as cancer, heart disease or HIV research. This results in a relatively small knowledge base to exploit in the discovery of novel therapeutics. Despite differences in metabolic pathways being elucidated in the 1970s and 1980s, few attempts have been made to exploit these in drug discovery. Inhibition of metabolic pathways in parasitic helminths would result in reduced growth or death of the pathogen. The major challenges are lack of knowledge about the biochemistry of the enzymes involved and the (perceived) difficulty of discovering reagents which are selective for parasite enzymes over the host ones. Hence, experiments demonstrating the vital nature of key metabolic enzymes are required.

According to the studies done by Guta Wertheim, Rodrigo Zeledon and Clark P. Read (1960) the tapeworms examined have very limited capacity for transamination. The finding that *H. nana* from squirrels can evidently carry out the amination of pyruvic acid with aspartic acid as the amino donor strongly indicates that the transaminases may be highly labile systems in their phenotypic expression. It would be of interest to determine whether this is an inducible system by experimental transplantation of worms from mice to squirrels and vice versa, a technique recently exploited in physiological studies on tapeworms (Goodchild, 1958; Schiller, 1959). The very limited capacity of these worms to carry out transaminations supports the general concept that they may utilize synthesis to a relatively minor extent in satisfying amino acid requirements. Recent kinetic studies by others in this laboratory indicated that tapeworms have a marked capacity for absorbing a variety of amino acids from the surrounding medium.

According to Yong Ok Min and Byong Seol Seo (1966) studies the demonstration of transaminase system may serve an open wedge in the problem concerning the intermediary metabolism of helminths. As per the studies transaminase activity in nematodes was observed to be very restricted. It suggests that these worms may utilize synthesis to a relatively minor extent in fulfilling amino acid requirements. Among trematodes higher transaminase activity was observed in tissue parasites than lumen dwellers. It suggests that tissue parasites cannot absorb required amount of amino acids from surrounding while intestinal parasites derives the same from host tissues or from food stuffs directly.

Most of the pioneer work done on helminth parasites of poultry birds. Studies on helminth parasites of poultry birds *Gallus domesticus* were initiated in the early 19th century itself by scientists. Many workers studied different aspects of helminth parasites of various hosts including Yamaguti, S.(1934, 1959), Woodland (1923, 1924), Woolcock (1935), Anderson (1976); Johri (1950), Moghe (1925), Bhalerao (1936), M.Z.Chishti (2004), R.Madhavi (2007), Nama, H.S. (1974), Pandey, K.C.(2007), Malhotra & Capoor (1992), Shinde, Jadhav, Bhure & his group(1970, 1980, 1984, 2005, 2006, 2010, 2015, 2018, 2019, 2020, 2021, 2022), etc. However, little work has been reported from Pune Region in general on *Gallus domesticus* L.

4. Objectives of the research and proposed hypothesis: -

- Taxonomic identification of Helminth parasites of *Gallus domesticus* from Pune District.
- To study the diversity of Helminth parasites of *Gallus domesticus* from Pune District.
- To study the Population Dynamics of helminth parasites of *Gallus domesticus* from Pune District.
- To study histopathological changes occurring in *Gallus domesticus* due to Helminthic infection.
- To study few aspects of biochemical changes (Glycogen, Pyruvate, Protein and Lipids, cholesterol) occurring in *Gallus domesticus* due to Helminthic infection. And to study enzyme activity in few helminth parasites of *Gallus domesticus*.

5. Methodology to be used and adopted:

- **Selection of Site:** Present study planned to be conducted in Pune district (M.S.).

Pune is the eight largest metropolitan in India which is located in Maharashtra State & is 2nd largest district. Pune district is located 560 m above sea level on the western margin of the Deccan plateau. It is very hilly and raised area with lots of hill stations Pune has dry and

tropical wet climate. The average temperature ranges between 20°C to 28°C. The district of Pune is affected by three seasons - monsoon, summer and winter.

- Collection of gastrointestinal tracts from different slaughter houses to examine helminth parasites. Collection & Preservation of parasites for further investigations such as taxonomy, population dynamics, biochemical & histopathological aspects.
- Gastrointestinal tracts of slaughtered domestic chicken for present investigation will be procured from local slaughter houses.
- Helminth parasites collected from host *Gallus domesticus* will be identified by Systema Helminthum Vol. I, II, III- By Yamaguti, S. (1934, 1958, 1959, 1961); Helminths, Arthropodes and Protozoa of Domesticated Animals By Soulsby (1982); Keys to the Cestode Parasites of Vertebrates by Khali *et al.*, (1994) & recent relevant research papers.
- For Study of Population Dynamics standard protocol will apply according to Margolis et.al., 1982.
- Histopathological studies will be carried out by the Standard methods described by Luna L.C., 1968; Pearse, A.G.E., 1968; Bancroft. J.D., 1975.
- Biochemical contents will be estimated by standard methods (Estimation of Glycogen by Kemp et. al., method, 1954; Estimation of Pyruvate by Friedmann and Haughen 1943 as described by Hawk 1954; Estimation of Protein by Gornall et. al., method, 1949 or Lowry et.al method, 1951; Estimation of Lipid by Folch et.al., method, 1957, Cholesterol by Crawford method, 1958; Enzyme activity by suitable standard method.)

6. Importance of study:

- **International status-**

Due to the global incidence of helminth infections in poultry birds, their detailed study would bear natural importance for handling these infections.

- **National Status-**

Parasites are one of the most serious limiting factors in poultry therefore present proposed investigation will sort-out population dynamics of helminth parasitic in poultry birds. Keeping in view the nutritional value of chicken, the present work is proposed to be done.

- **Regional Status-**

Gastrointestinal helminth parasites are a concern for the poultry industry not only the worldwide but also as regional level as they can affect the health, welfare and production

performance. A systematic review of the infection/ prevalence over time in different areas of different countries may improve our understanding of gastrointestinal helminthiasis in chickens and subsequently lead to improved poultry health. Keeping in view the increasing importance of poultry as a cheap source of protein rich diet. The aim of this present systematic study is proposed to investigate some important aspect of biosystematics of helminth parasites of domestic fowls from Pune district, and provide an overview of the information for epidemiology and diagnostic approaches of chicken helminth infection.

- **Scope of study-**

Helminth parasites have been a major cause of ill-health and loss of chicken productivity in different parts of the world, including India. Endoparasites affect the intestine and cause nodules and severe enteritis, thus impairing the absorbing power of the intestine for nutrients and vitamins from the host (Hayat & Hayat, 1983). Borghare et al. (2009) indicated that this infection leads to loss in body weight, delay growth, reduced egg production, weakened body resistance and even death. The parasitic infection of chicken causes loss of their economic value. The prevalence of parasites varies considerably from one geographic region to another. It is therefore necessary for periodic surveillance of the prevalence of these parasites within a given locality for successful formulation and implementation of an effective control strategy. It will help to know the helminth parasites fauna which infect domestic fowl.

7. Proposed work Plan with a Tentative chapter scheme:

1. Introduction
2. Preface
3. Review of Literature
4. Geographical Background of Research Area
5. Materials and Methods
6. Result & Discussion
    - I) Taxonomy of Helminth Parasites
    - II) Diversity of Helminth Parasites
    - III) Population Dynamics
    - IV) Histopathological Study
    - V) Biochemical Study
7. Summary & Conclusion
8. Bibliography

8. Year wise Plan of work and targets to be achieved:

First Year:- Historical Review, Collection of gastrointestinal tract from slaughtered house, collection of helminths. Collection and preservation of helminth parasites of domestic fowl. To record the obtained data for Population Dynamics. To study Biochemical aspects for Glycogen,

Protein and Lipid contents of Helminths and its host tissue. Assessment of Histo-pathological alteration induced by Helminths of *Gallus domesticus.*

Second Year:- Collection, Fixation, preservation, dehydration, staining and whole mount preparation of helminth parasites. Record the obtained data for population dynamics of helminth parasites & data analysis. To study Biochemical aspects for Glycogen, Protein and Lipid contents of Helminths and its host tissue. Assessment of Histo-pathological abnormilities induced by Helminths of *Gallus domesticus*

Third Year:- Collection, preservation, staining, mounting, Camera Lucida drawings, morphometry and identification of helminths on the basis of Systema Helminthum by S. Yamaguti. Confirmation and finalization of obtained data for Biosystemics studies.

Fourth Year:- Confirmation and finalization of obtained data for Biosystemics studies. Camera Lucida drawings, morphometry, photomicrography, data analysis, compilation, writing, Typing and submission of thesis.

9. Expected Outcome:

Helminth infections inflict negatively on the production and well-being of animals including poultry.

- This study will help to know the diversity, population dynamics of helminth parasites of *Gallus domesticus* from Pune District.
- Histopathological studies will help to understand effect of infection on host organs or tissues & will also help in diagnosis of severity of infection.
- Biochemical studies will help to understand changes that are occurring in infected host with reference to few important bimolecules such as protein, glycogen, lipid content of host as compared to non infected host. Information from studies based on enzymes of parasites will help to find some efficient treatment or control method for such infections.

After the completion of this study, It will help to know the taxonomic diversity, distinctness, abundance & histopathogenesity of helminth parasites of domestic fowls from Pune district. The baseline information will helpful for rapid diagnosis of infection, successful formulation and implementation of an effective control strategy. This study will provide information that will be helpful to improve poultry management system and to the some extent it will be useful to defeat the problem caused by such helminthic infections.

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